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GIFFORD PINCHOT, Forester.

HOLDING FORCE OF RAILROAD SPIKES IN WOODEN TIES.

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HOLDING FORCE OF RAILROAD SPIKES IN WOODEN TIES.

PURPOSE OF TESTS.

Any increase in the practise of prolonging the life of ties by the use of preservatives, with the resulting economy of forest resources, depends largely upon the adoption of improved forms of spikes and fastenings. The use of the improved screw spike has been described in Bulletin 50 of the Forest Service. The purpose of the tests cov-

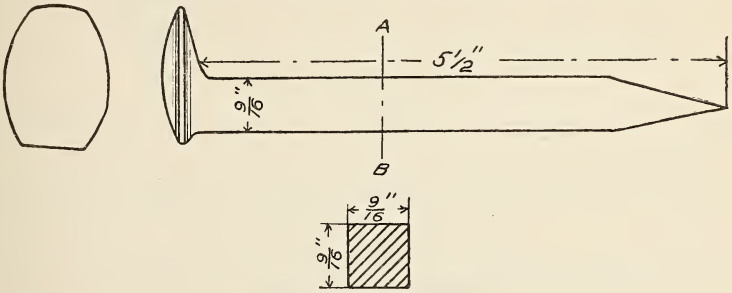

FIG. 1.—Common spike.

ered in this circular was to compare the relative holding force of common, channeled, and screw spikes when driven into railroad ties of both hard and soft woods.

The ties were in different states of seasoning and some had been treated with preservatives. Spikes of the various forms were driven

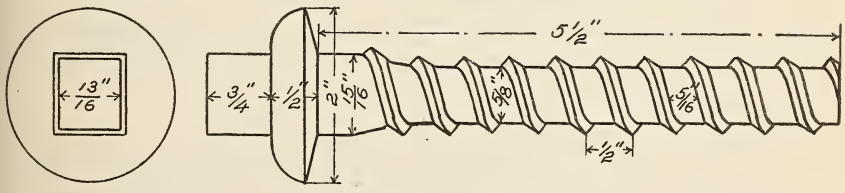

FIG. 2.—Common screw spike.

into the same tie. The results do not necessarily show in general the relative capacity of various species to hold spikes. They compare the action of the spikes.

The spikes used, the dimensions of which are shown in the accompanying diagrams, were—

(1) Common spikes, weight 165 spikes to 100 pounds. (See figure 1.)

(2) Common screw spikes, similar to those in use on the French and other continental railroads, weight 85 spikes to 100 pounds. (See figure 2.)

(3) Channeled spikes, weight 200 spikes to 100 pounds. These spikes are of about the same form as the common spikes, with the

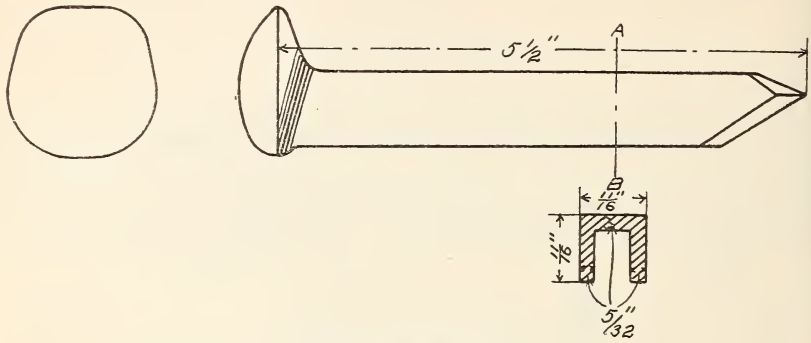

FIG. 3.—Channeled spike.

addition of a channel cut lengthwise in the side away from the rail. (See figure 3.)

(4) Illinois Central screw spikes, weight 85 spikes to 100 pounds. (See figure 4.)

The only apparent difference between the two forms of screw spikes is in the manner of finishing the thread under the head.

METHOD OF TESTING.

The common and channeled spikes were driven into the tie in the usual way to a depth of 5 inches. For the screw spikes a hole was first bored of the same diameter as the spike at the base of the thread, and the spike was then screwed down to the same depth as the driven spikes. No spike was used a second time. A special steel claw was constructed for gripping the spikes and pulling them from the tie in the direction of their length. The tie containing the spike

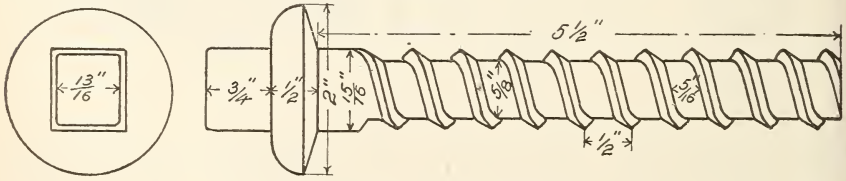

FIG. 4.—Illinois Central screw spike.

was placed on top of the fixt head of a testing machine, so that the head of the spike extended into the opening in the center of the head of the machine. The pulling device was then slipt under the spike head and its shank attached to the movable head of the machine. The descent of the movable head drew out the spike.

RESULTS OF TESTS.

The results of the tests are shown in Tables 1 to 6, pages 6 to 7.

Table 1 compares the efficiency of the common and screw spikes and shows that the latter resist withdrawing with from two to three times the force of the former. The advantage of the screw spike becomes more marked in the softer woods.

Table 2 shows that in soaked loblolly pine the channeled spikes have about 60 per cent of the holding power of screw spikes, and about 12 per cent more holding power than common spikes. Because of the channel in the channeled spikes they distort the wood fiber less than do the common kind.

Table 3 shows that in loblolly pine the Illinois Central spikes and the ordinary screw spikes have practically the same holding power, as would be expected from their similarity in form. The force required to pull them is about double that required for common spikes.

Table 4 shows that seasoned ties have a greater holding power than steamed ties.

Table 5 shows that a knotty tie has about 25 per cent less holding power for common spikes than a clear tie, while with screw spikes the conditions are reversed, since a knotty tie has 35 per cent greater holding power for these spikes than a clear one.

Table 6 shows that the holding power of a natural tie and of one steamed for four hours at 30 pounds pressure is about the same. Steaming for four hours at less than 30 pounds appears to increase the holding power, while steaming for more than four hours at 20 pounds decreases it. Ties steamed and creosoted or steamed and treated with zinc chlorid appear to have less holding power than those simply steamed.

TABLE 1.—*Holding force of common and screw spikes.*

Species of wood and kind of spike.	Number of tests.	Condition of wood.	Force required to pull spike.		
			Average.	Maximum.	Minimum.
			Pounds.	*Pounds.*	*Pounds.*
White oak:					
Common spike	5	Partially seasoned	6,950	7,870	6,160
Screw spike	5	do	13,026	14,940	11,050
Ratio			1.88		
Oak (probably red):					
Common spike	5	Seasoned	4,342	5,300	3,490
Screw spike	8	do	11,240	13,530	8,900
Ratio			2.61		
Loblolly pine:					
Common spike	28	Seasoned	3,670	6,000	2,320
Screw spike	26	do	7,748	14,680	4,170
Ratio			2.11		
Hardy catalpa:					
Common spike	12	Green	3,224	4,000	2,190
Screw spike	14	do	8,261	9,440	6,280
Ratio			2.56		
Common catalpa:					
Common spike	11	Green	2,887	4,500	2,240
Screw spike	11	do	6,939	8,340	5,890
Ratio			2.42		
Chestnut:					
Common spike	4	Seasoned	2,980	3,220	2,600
Screw spike	5	do	9,418	11,150	7,470
Ratio			3.15		

TABLE 2.—*Holding force of channeled, screw, and common spikes.*

SOAKED LOBLOLLY PINE TIES (NATURAL AND STEAMED).

Kind of spike.	Number of tests.	Force required to pull spike.		
		Average.	Maximum.	Minimum.
		Pounds.	*Pounds.*	*Pounds.*
Channeled	46	4,010	6,640	2,530
Screw	46	6,585	12,070	3,980
Common	44	3,570	5,450	2,450

TABLE 3.—*Holding force of Illinois Central screw spikes, common screw spikes, and common spikes.*

SEASONED LOBLOLLY PINE TIES (NATURAL AND STEAMED).

Kind of spike.	Number of tests.	Force required to pull spike.		
		Average.	Maximum.	Minimum.
		Pounds.	*Pounds.*	*Pounds.*
Illinois Central screw	20	7,089	9,600	5,000
Common screw	16	6,945	9,740	4,170
Common	14	3,494	6,000	2,320

TABLE 4.—*Holding force of screw, common, and channeled spikes.*

TIES SEASONED AND SOAKED.

Seasoning condition.	Force required to pull spike.					
	Screw.		Common.		Channeled.	
	Number of tests.	Pounds.	Number of tests.	Pounds.	Number of tests.	Pounds.
Seasoned [a]	26	7,748	16	3,598	.....	.....
Seasoned [b]	16	6,945	14	3,494	.....	.....
Soaked [b]	46	6,585	44	3,570	46	4,010

[a] Natural wood. [b] Natural and steamed ties.

TABLE 5.—*Holding force of common and screw spikes.*

SEASONED CLEAR AND KNOTTY LOBLOLLY PINE TIES.

Position of spike.	Kind of spike.	Number of tests.	Force required to pull spike.		
			Average.	Maximum.	Minimum.
			Pounds.	*Pounds.*	*Pounds.*
In clear wood	Common	36	3,466	6,250	1,880
In knotty wood	do	18	2,615	3,750	1,010
In clear wood	Screw	40	7,180	13,710	2,600
In knotty wood	do	20	9,763	17,200	4,890

TABLE 6.—*Effect of cylinder operations on the holding power of lobolly pine for screw spikes and common spikes.*

SEASONED TIES.

Treatment.	Screw spike.		Common spike.	
	Number of tests.	Force required to pull spike.	Number of tests.	Force required to pull spike.
		Pounds.		*Pounds.*
Steam 4 hours at 10 pounds	32	9,185	32	3,983
Steam 4 hours at 20 pounds	32	8,028	32	3,942
Steam 4 hours at 30 pounds	32	7,753	32	3,471
Steam 4 hours at 40 pounds	31	7,209	32	2,803
Steam 4 hours at 50 pounds	30	6,234	30	2,528
Steam 2 hours at 20 pounds	32	7,584	32	3,369
Steam 6 hours at 20 pounds	30	6,435	30	2,842
Steam 10 hours at 20 pounds	32	6,513	32	2,763
Steamed and creosoted	30	5,281	18	2,448
Steamed and zinc chlorid	26	5,838	20	2,657
Natural	26	7,748	16	3,598

Approved:

JAMES WILSON,

Secretary.

WASHINGTON, D. C., *September 18, 1906.*

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